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TEST 9 — CHILLED-WATER SYSTEM USING CENTRIFUGAL CHILLER, ADVANCED ENERGY-EFFICIENT DESIGN

Choose the correct answer (from the choices in **bold**) for each of the following hvac situations, referring to the schematic diagram on this page.

1 On-off control in the "off" position:

Centrifugal chiller CC-1 is (**on, off**), primary chilled-water pump P-1 is off, secondary chilled-water pump P-3 is off, condenser water pump P-2 is off, and "draw through" cooling tower fan is off.

2 On-off control in the "on" position:

CC-1's on-off switch at the unit control panel CP-1 is placed in the "on" position, but the refrigerant process does not start. Interlock (**control, power**) signals from chiller control panel CP-1, to chilled-water pump P-1 and P-3 and condenser water pump P-2. Start all three pumps. Chilled-water flow switch FS-1 senses flow and confirms P-1 is delivering sufficient flow for CC-1 to start. Condenser water flow switch FS-2 senses flow and confirms P-2 is delivering sufficient flow for CC-1 to start. CC-1 centrifugal refrigeration cooling process begins.

3 On-off control in the "on" position:

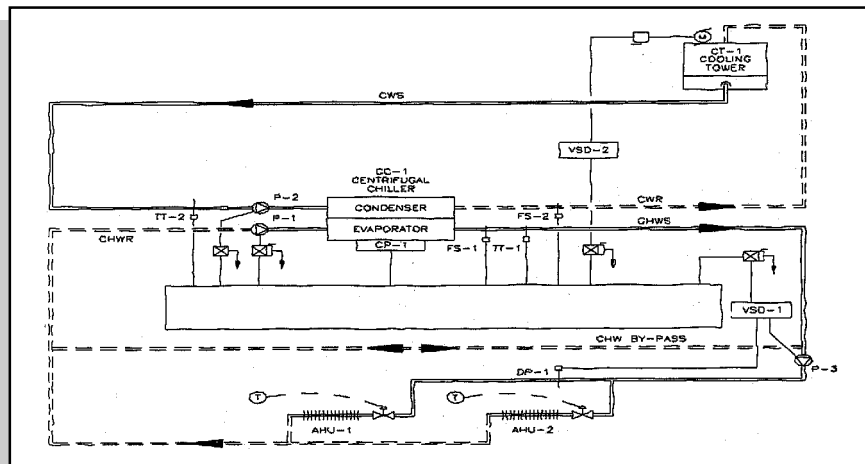
With chilled-water flow, system pressure will begin to increase and differential pressure transmitter DP-1 shall begin to control the secondary chilled-water flow via variable-speed drive VSD-1 (sequence noted below). Chilled-water supply temperature control transmitter (TT-1, TT-2), set at 45 F, shall maintain supply water temperature setpoint by modulating the chiller CC-1 self-contained centrifugal refrigeration controls within control panel CP-1.

4 On-off control in the "on" position:

Condenser water supply temperature control transmitter TT-2, set at 85 F, shall maintain supply water temperature setpoint by (**starting, stopping**) cooling tower fan CT-1, controlling fan speed via variable-speed drive VSD-2, and stopping fan CT-1. On a rise in condenser water supply temperature, 3 F above 85 F, CT-1 fan shall start at (**low, normal, high**) speed. If condenser water supply continues to rise, fan speed will increase towards maximum airflow via VSD-2. When condenser water temperature drops towards 85 F, CT-1 fan shall reduce speed and stop when condenser water supply temperature drops below the 85 F setpoint.

5 Maximum cooling:

Chiller CC-1 shall be providing maximum cooling capacity, and secondary chilled-water supply pump (**P-1, P-2, P-3**) shall be at maxi-



mum flow via VSD-1 pump speed control. Air-handling units' straight-through chilled-water valves shall be open 100%, drawing off all the chilled water for space cooling and/or dehumidification needs. Cooling tower CT-1 fan shall be operating continuously.

6 Minimum cooling:

Chiller CC-1 shall be providing minimum cooling capacity, and secondary chilled-water supply pump P-3 shall be at (**minimum, normal, maximum**) flow via VSD-1 pump speed control. Air-handling units' straight-through chilled-water valves shall modulate toward the closed position, reducing the need for chilled water for space cooling and/or dehumidification needs. Unused primary chilled water shall be bypassed (**downstream, upstream**) of P-3 via chilled-water bypass loop to maintain sufficient chilled-water flow through CC-1. Cooling tower CT-1 fan shall be off.

7 Differential pressure control:

Variable-speed drive (**VSD-1, VSD-2**) shall control the pump speed of P-3 based on a differential pressure-control transmitter signal that senses variations in chilled-water system pressure. Starting at low speed, VSD-1 shall allow P-3 flow to (**decrease, increase**) based on a need to increase system pressure. When chilled-water supply pressure exceeds the DP-1 setpoint (in psig), P-3 shall begin to reduce speed via VSD-1.

If you have any questions regarding the Advanced Energy-Efficient Design — Commissioning test, send your concerns, questions, and/or comments to: Rebecca Ellis, P.E., 612-546-0494 (Fax); rellis@sebesta.com (e-mail).

ANSWERS FOR ADVANCED ENERGY-EFFICIENT DESIGN — COMMISSIONING:
1. a) off; b) before; 2. a) minimum; b) FS-1 and FS-2; 3. a) VSD-1; 4. a) P-3; 5. a) stops; 6. a) VSD-2; b) increases; 7. a) maximum.

